

micrographs. The outcome of the coordinated work on structure and function was an ingenious account of the lysosome mechanism.

#### 4. CONCLUSION

By the 1960s the efforts begun in the 1940s bore fruit in the articulation of a number of mechanisms operative in the cytoplasm of the cell. Understanding these mechanisms required the collaborative effort of morphologists and more functionally oriented investigators. Two of these efforts followed up on the initial forays at Rockefeller and elsewhere in the 1940s in identifying the mitochondrion as the power plant of the cell and identifying the microsomes and what came to be known as the endoplasmic reticulum as new components of the cytoplasm. In the case of the mitochondrion, these efforts led not only to an understanding of why the enzyme systems responsible for cellular respiration always involved a membrane component but also of how the membrane played a crucial role in the actual functioning of the mechanism. In the case of the endoplasmic reticulum, researchers not only identified the major steps in which the ribosomes and other RNA constituents operate to synthesize proteins, but also determined the role of the membranes in structuring environments for the newly synthesized proteins destined for export. Investigations in the 1950s and 1960s also finally established the reality and function of the Golgi apparatus, which had been the focus of bitter battles during the first half of the twentieth century. By discovering the process of migration from the rough endoplasmic reticulum through the smooth endoplasmic reticulum into the Golgi region and then into secretory vesicles, investigators came to recognize the Golgi apparatus as playing crucial roles in the preparation of proteins for export. And finally the discovery of the lysosome as a new organelle rich in hydrolytic enzymes provided the basis for developing the basic account of how cells digested either foreign substances brought into the cell or worn out cell components. By the 1960s cell biologists recognized that the cytoplasm was rich in mechanisms that play critical roles in the maintenance of cell life and understood the major parts and operations in each mechanism.